

The Effects of Computer-Enhanced Reading Aloud on the Production of
/p/ and /ε/ in Arabic-English Interlanguage

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ABSTRACT

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This study explores the effects of second language learners' Reading Aloud (RA) of texts on their pronunciation. RA has not received much attention in empirical research despite being commonly used in classrooms. The handful of available studies found that RA led to the improvement of L2 learners' pronunciation at the segmental and the suprasegmental levels. The present study contributed to fill this gap in the literature by investigating, using a mixed-methods approach, the effects of RA on the acquisition of the phonemes /p/ and /ε/ in the speech of Arab speakers learning English as an L2. Twenty-six adult Arab ESL learners participated in this study. The participants were randomly assigned to a control group and an experimental group. The latter were asked to practice reading written texts out loud to their smartphone devices through automatic speech recognition (ASR) application, which enabled them to monitor their own production and receive instantaneous visual feedback (i.e., in the form of written text). By the end of the experiment, the participants in the treatment group were asked to conduct a one-to-one interview with the researcher on their attitudes towards the usefulness of RA. The pre-test results showed that the participants in both groups had no major difficulties in producing /ε/; henceforth, the investigation focused solely on /p/. The treatment group's oral production of /p/ during reading aloud and spontaneous speech tasks significantly improved from the pre-test to the posttest and the delayed post-test.

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Chapter 1: Introduction

Based on my ESL teaching experience, conversations with colleagues, and findings of some research (e.g., Collins & Horst, 2010; Horst, Collins, & Cardoso, 2009; Isaacs, 2009), it seems that the time dedicated to pronunciation teaching is insignificant compared to the time spent to develop skills such as vocabulary and grammar. L2 teachers and learners mostly focus on developing grammar, syntax, vocabulary, and listening and reading comprehension, which could be one of the reasons why L2 learners' performance in these skills do not match that of pronunciation (Celce-Murcia, 2010).

In addition, many L2 teachers tend to use metalanguage to explain phono-phonetic features (e.g., involving place and manner of articulation, aspiration) and adopt methodologies that are based on meaningless mechanical drills, which could be boring and demotivating for some learners. This tendency may be partly due to the inconclusive research findings on the most effective forms of L2 pronunciation instruction (Derwing, Munro, & Wiebe, 1998; Ibarrola, 2011). Consequently, some teachers find it difficult to adopt a particular teaching approach, and eventually develop their own teaching methodologies for pronunciation; others may choose not to include the pronunciation component in their programs at all.

Research has paid little attention to the role of instruction in the improvement of L2 pronunciation (Couper, 2006; Deng et al., 2009; Derwing & Munro, 2005) and, accordingly, further research is needed to bridge the gap between theory and classroom teaching practices to improve this skill.

The Present Study

This study aimed to investigate the effects of students' reading aloud (RA) on improving their L2 pronunciation. The idea was inspired by my own experience as an ESL teacher and motivated by the lack of research on this topic. From anecdotal evidence compiled from my students, RA helps raise their awareness of their oral production and recognize how close they are to the target pronunciation. In my experience, the task of asking my students to read passages out loud triggered their curiosity and changed their learning behaviors. They took the initiative to use dictionaries to check the pronunciation of words instead of definitions, and they asked for specific feedback to correct their errors, which helped them develop autonomy and learning strategies.

Many of my colleagues and students reported similar positive effects of RA in raising learners' awareness for the gap between their production and the target production, which served as an incentive for learners to make the necessary modifications and monitor their output during free speech. This promotion of a learner-centered teaching strategy could be enhanced by the incorporation of recently developed technologies such as automatic speech recognition (ASR; see forthcoming discussion). Through the use of ASR, teachers can promote learners' autonomy by encouraging them to recognize their own problems and find appropriate and personalized strategies to resolve them. Therefore, I decided to conduct this research to examine the extent to which RA can improve L2 learners' production of L2 English /p/ and /ε/ using free commercial ASR application installed in their electronic mobile devices.

This thesis is organized as follows: Chapter 2 provides a literature review that discusses RA from different perspectives: a theoretical perspective, which demonstrates how RA embodies different theories and hypotheses on second language acquisition; the educators' perspective,

which discusses L2 instructors' accounts of RA contribution in their classrooms; RA and Automatic Speech Recognition (ASR), which explains how ASR can enhance RA-based instruction; and findings from relevant research that investigated the effects of RA on the acquisition of L2 pronunciation. Chapter 3 describes the methodology used in this study and chapter 4 reports the findings of all testing phases. The final part, chapter 5, provides a discussion on the findings, conclusions, and suggestions for future research.

Chapter 2: Literature Review

Reading Aloud and Effects on L2 Acquisition

RA and L2 Orthographic Transparency. Aside from the external factors that may affect learners' development of L2 pronunciation (e.g., age, L1 influence, exposure, motivation, affective filter), the transparency of L2 orthography may constitute another challenge for learners. Research on orthographic transparency (i.e., consistency of sound-symbol correspondences) revealed that English is one of the least transparent languages because the same letter can be pronounced in different ways. For example, the letter 'u' in *cut*, *cute*, and *measure* has three different oral realizations. This aspect of English orthography constitutes a major obstacle for learners to acquire the English phonological system (Ellis, 2004; Randall, 2007; Sprenger-Charolles, Siegel, Jimenez, & Ziegler, 2011). One of the challenges these learners encounter is how to pronounce low frequency or unfamiliar words that contain letters that do not correspond to their sounds.

RA could be an effective activity to provide learners with ample practice opportunities in order to raise their awareness for these types of grapheme-to-phoneme inconsistencies. During reading, learners have to focus on decoding the graphemes of words while transforming printed text into speech. In this decoding process, learners engage in two levels of cognitive processing as posited by the dual-route theory of RA.

RA and the Dual-Route Theory. According to the dual-route theory, there are two cognitive processes involved in word recognition during RA, the grapheme-phoneme route (also known as non-lexical or indirect route) and the lexical route (e.g., Coltheart, 2000; Coltheart, 2005; Pritchard, Coltheart, Palethorpe, & Castles, 2012; Randall, 2007). In the former, learners

engage in analytical decoding of single graphemes in order to retrieve the corresponding phonemes. In the latter, a holistic recognition of words occurs as a result of learners' familiarity with those words. The use of the two routes are necessary for English L2 learners in order to be able to decode and recognize irregular correspondences between graphemes and phonemes, a novel phenomenon for English learners whose L1s are more transparent (i.e., there is a clear one-to-one relationship between letters and sounds in their L1). This principle of the dual-route theory is further illustrated by Randall's (2007) discussion of learners' bottom-up and top-down processing of texts during reading.

Randall pointed out that during reading, L2 learners, particularly those of lower L2 proficiency, engage more in bottom-up processing of written text. In other words, these learners focus more on the graphemic, morphological, and phonological levels of the written text, which may exhaust their attention and processing capacity to engage in the top-down processing of texts (i.e., syntactic and semantic features, text context, and cultural schema). In this scenario, RA could be an appropriate practice for L2 learners to engage in bottom-up processing and thus focus on pronunciation rather than on the comprehension of written texts. The fact that readers are consciously involved in decoding pronunciation features of English orthography may help them process L2 printed letters as graphemes and raise their awareness of the inconsistent grapheme-phoneme correspondences.

RA and Input/Output Theories. According to the input hypothesis, written and spoken forms of language are the sources of input to which language learners have access. Thus, reading and listening are the means through which learners acquire language (Krashen & Terrel, 1983; Krashen, 1982). Although the input hypothesis revolves around the importance of

comprehension, the means through which the input is delivered (i.e., reading and listening) are relevant to the role of RA. Reading, the main property of RA, could be an effective source of input for L2 learners in terms of providing visual written form of L2 which helps learners establish the relationship between graphemes and phonemes. Moreover, while L2 learners are reading out loud, they are listening to their own voice which would enable them to monitor their production. So, RA could be an effective source of input in the sense that it combines both spoken (produced by learners) and written forms (the reading of words, sentences, and passages) that are processed simultaneously by learners themselves.

The output hypothesis (Swain & Lapkin, 1995) proposes that effective learning requires opportunities for production, namely speaking and writing. The output helps learners develop fluency, pushes them to process language at different linguistic levels (e.g., phonology, syntax, lexis), engages them in testing their hypotheses about language, and provides an opportunity to receive feedback. RA can then provide an opportunity for learners to produce lengthy utterances, which would allow them to test their knowledge about the target language, compare their interlanguage to what is acceptable or unacceptable, and potentially develop fluency.

Swain and Lapkin (1995) posited that production helps learners notice and eventually modify their errors. During RA-based oral production, for example, learners can consciously monitor their pronunciation, and, consequently, they are likely to notice the gaps between their own production and the intended target output. Thus, input and output are equally important and constitute the means of L2 exposure. This exposure could sometimes lead to improvement in L2 pronunciation even without explicit instruction (Flege & Liu, 2001; Munro & Derwing, 2008; Rachell, 2008; Trofimovich, 2006). Munro and Derwing (2008), for example, found that ESL

Mandarin and Slavic students' pronunciation improved significantly through exposure to spoken English with no explicit instruction.

RA and L2 Cognitive Processing Techniques. Regarding learners' cognitive processes activated during L2 exposure (e.g., hypothesis testing, noticing errors, monitoring production), Odisho (2007) posited that the development of L2 pronunciation entails the implementation of multi-cognitive techniques. The latter refers to techniques that trigger learners' cognitive processes such as conscious thinking, association, analysis, synthesis, comparison, and memorization, which enable them to perceive and recognize new sounds. RA could help learners overcome what he termed "psycholinguistic deafness" in rejection of fossilization.

Odisho rejects the concept of fossilization mostly associated with adult L2 acquisition, pronunciation in particular, for the fact that all learners are able to improve their pronunciation provided that the instruction incorporate multi-sensory (auditory, visual and tactile-kinesthetic) and multi-cognitive techniques. The multi-cognitive techniques should encourage learners to attentively compare and contrast the target oral production with sounds already part of their psycholinguistic inventory using all the available cognitive resources that may lead to the retention of the target-like pronunciation. RA is one of these techniques that stimulate learners' cognitive processes and enable them to perceive errors and problematic features. With constant RA practice, learners may internalize their modified output and ultimately transfer it to free speaking. Randall (2007) supports this hypothesis and further asserts that L2 learners' output at first relies on written texts, but through practice and rehearsing, they may internalize and automatize the target production in speaking. RA may help L2 learners reduce their dependence

on visual input through extensive rehearsing and promote natural target-like production just as listening does.

RA and the Affective Filter Hypothesis. One common criticism against using RA in classrooms is that it may cause anxiety for some learners. According to the affective filter hypothesis, learners' anxiety may hinder learners' L2 development (Krashen, 1982). However, compared to spontaneous speaking tasks, RA provides a risk-free environment that is likely to lessen learners' anxiety during production (Gibson, 2008; Ibarrola, 2011; Horwitz, 2001).

Learners are more anxious when they are asked to speak about a particular topic because they have to be accurate and fluent at all linguistic levels. For instance, they have to retrieve relevant vocabulary, construct accurate structures, and produce intelligible and comprehensible output each time they have to express their ideas. This could be frustrating for some learners, especially the less proficient ones. Asking L2 learners to speak spontaneously is one major factor that causes learners' anxiety, a feeling that discourages learners to communicate orally (Krashen, 1982). RA could be implemented as an alternative or a facilitator to help learners overcome their anxiety. During RA, learners are likely to feel more confident in producing lengthy discourse orally because the relevant content and structure of the intended speech is visually available in the form of printed text. In addition, they can engage in RA activities alone (e.g., in a secluded place at home), without the presence of their peers or the teacher.

The conclusion that we can draw from the above discussion is that RA has, from a theoretical perspective, the potential to contribute to the development of L2 pronunciation. The dual-route theory demonstrated that RA helps raise learners' awareness of grapheme-phoneme relationship, particularly of less transparent languages such as English. The discussion of the

input and output hypotheses revealed that RA enhances learners' exposure to L2 through reading, listening, and producing long discourse. Furthermore, learners activate cognitive processes that can help them perceive the gaps between their production and the target production. Last, RA could be used as a tool to help resolve anxiety issues as suggested by the affective filter hypothesis. RA minimizes learners' anxiety because they are likely to feel safe about not losing face, and, more importantly, they do not have to plan their messages and construct utterances, which frees their processing capacity to focus on pronunciation.

Reading Aloud: The L2 Educator's Perspective

Criticism against RA. RA activities have been neglected in many approaches to second language acquisition, from Audio-Lingual to Communicative Language Teaching. On the one hand, it was believed that languages are first learnt through speaking and listening and that reading and writing should be introduced later after learners develop speaking skills (e.g., Richards & Rodgers, 1986). On the other hand, RA was criticized for focusing on decoding graphemes at the expense of meaning and that it has no communicative value (Gabrielatos, 2002; Gibson, 2008; Randall, 2007). However, RA is a popular methodology used in many teaching contexts and adopted in classrooms by many L2 teachers (Gabrielatos, 2002; Gibson, 2008), as will be discussed next.

RA as a Pedagogical Technique. Griffin (1992), an experienced ESL teacher, support the idea that RA, as opposed to silent reading, helps learners develop grapheme-phoneme relationships. In addition, in a Washington state survey of ESL teachers, Griffin (1992) found that more than 80% of the teachers who responded used RA in their classes on a regular basis. The majority of these teachers found RA beneficial for all proficiency levels. They thought it

helps ESL learners enrich their vocabulary, develop awareness of the sounds of the language, facilitate chunking words in meaningful groups, and develop self-confidence. They also found it an effective technique that could be used to expose and identify learners' problematic interlanguage features (e.g., pronunciation, morphosyntax) that require pedagogical interventions.

Kelly (2000) also found RA useful in improving his students' intelligibility. These students had serious issues regarding intelligibility and comprehensibility even after 10 to 15 years of ESL learning, an example that illustrates the consequences of neglecting L2 pronunciation. Kelly taught conversational classes to adult Chinese engineers using situational dialogues proposed in different conversation textbooks. Because there was no noticeable improvement in learners' ability to sound intelligible, the teacher resorted to RA. His rationale was "If you're going to listen as a way to speak a language, you must speak aloud." The idea was to combine silent reading, which the students were good at, with listening (i.e., listening to the teacher's or their peers' oral reading) and speaking.

The teacher used newspaper articles and his method comprised three phases. First, the whole class participated in discussing the theme of the articles. Second, the teacher read the articles out loud and explained new vocabulary. Then, students took turns reading the target text orally. At this stage, the teacher gave feedback on pronunciation and asked students to repeat words or sentences until they were produced naturally. In the final part of the lesson, the whole class engaged in discussing the article. The teachers' rationale for using this method, which aligns with the purpose of using RA in this research, is to focus on learners' pronunciation. The students became familiar with the topics of the articles, and realized that what they needed to

work on was their pronunciation. According to Kelly (2000), contrary to silent reading, RA allows learners to produce all the words orally, hear their own pronunciation, and even assess and correct themselves. The fact that these learners were exposed to the target pronunciation and read the articles out loud followed by a discussion of the readings encouraged them to recycle the target language and ultimately speak more intelligibly.

Acton (1984) and Huang (2010) suggested two L2 pronunciation teaching methods in which RA was an integral part. Acton (1984) described an intervention method of seven techniques to help ESL professionals treat highly fossilized pronunciation errors. The seven features were conversational control, monitoring strategies, non-verbal correlates of pronunciation, dictionary use, oral reading, informant use, and integration. Regarding RA, the author stated that it gives students a context which permits them to concentrate on accuracy, forces them to listen to and analyze their own speech through self-correction of their daily errors, and helps them to develop better control of rhythm. Gibson (2008) also supports the fact that RA pushes readers to make and practice accurate connections between graphemes and phonemes in order to speed word recognition. The author conducted a survey with teachers (12 native speakers and 15 non-native speakers), ESL learners, and autonomous learners on their use of RA. She found that teachers and learners use RA for many reasons (e.g., learning vocabulary, building up confidence when speaking), but mainly for improving pronunciation, particularly intonation. Other main reasons were for speaking practice, making graphemic-phonemic connections, diagnosing pronunciation problems, improving fluency, and practicing reading skills. Another interesting finding was that 82 per cent of the autonomous learners read out loud to themselves as part of private studying to practice intonation and develop pronunciation.

Huang's (2010) method adopted five functions of RA in foreign language teaching: practice pronunciation, improve oral English, get deeper understanding, strengthen knowledge, and improve the classroom environment. In the first two functions, which are relevant to this study, learners are believed to improve their spontaneous speech through RA practice. Huang posited that RA is a "comprehensive practice" of L2 pronunciation in the sense that it enables learners to practice accurate pronunciation of words and produce appropriate stress, intonation, and rhythm. The practice function of RA provides opportunities for learners to develop natural pronunciation habits especially those who do not feel confident or are not proficient enough to be able to speak spontaneously.

Based on the above accounts of L2 educators, one can hypothesize that RA could be used as a pedagogical technique with the potential to improve learners' pronunciation in the target language. Moreover, RA allows learners and instructors to address specific and individualized pronunciation problems. Instead of following a prescriptive pronunciation syllabus for L2 learners as a group, RA could be used to zoom in on individualized problems that need urgent intervention.

Reading Aloud and Automatic Speech Recognition

One way in which RA can be used independently by the students is via Automatic Speech Recognition (ASR), a computer-based application that translates spoken words into text. It can be found on standard computers and in mobile devices such as smartphones and other media players. As indicated earlier, I adopted a free version of mobile ASR because it encourages autonomous learning (Liakin, Cardoso, & Liakina, 2014), enhances some of the benefits of RA, and is likely to address some criticisms held against RA. As I pointed out earlier,

RA provides opportunities for exposure to L2 pronunciation, individualized diagnosis of learners' production, and risk-free environment that reduces learners' anxiety. With recent developments in ASR technology, it is possible to enhance these benefits.

ASR encourages learners to interact one-to-one with computers or portable devices in order to practice their pronunciation at their own pace, convenience, and without disrupting the course of their regular L2 classes. In addition, ASR provides immediate feedback of oral production via orthography, in real time. Some special ASR applications can assess and score learners' oral production by comparing their pronunciation to a variety of stored native speakers' productions; it can detect and locate pronunciation errors; and it can specify the type of errors speakers make (e.g., Hincks, 2005; Neri, Cucchiarini, & Strik, 2003). All of these interactions with ASR provide instantaneous and individualized feedback.

ASR can also address the criticism that RA is time consuming for classroom use. Because of its widespread use and portability (e.g., in mobile devices), ASR can be used to extend the reach of the classroom, outside of the traditional learning environment. Instructors can assign RA-based activities as assignments or supplementary practice in which learners would interact with ASR on their own (Neri, Cucchiarini, & Strik, 2003). With the recent development in ASR technology, it is now possible for learners to practice RA using their mobile devices such as smartphones and iPads. Mobile ASR is more convenient for learners because they can practice RA anywhere and at any time.

The present study adopted mobile ASR not only because of the benefits discussed earlier (i.e., personalized learning, immediate and individualized feedback, and mobility) but also for the encouraging research findings. Many studies on the use of ASR found that it has positive

effects on the development of learners' L2 pronunciation (Cucchiarini, Neri, & Strik, 2009; Hincks, 2003; Hincks, 2005; Liakin, Cardoso, & Liakina, 2013; Mak, 2003; Tomokiyo, Wang, & Eskenazi, 2000). For example, Liakin et al. (2013) investigated the effects of mobile ASR on the acquisition of L2 French /y/. Although the ASR group (i.e., the group that received the treatment through mobile ASR) did not make statistically significant gains in the perception of /y/, they outperformed the non-ASR group and the control group in production. These promising results encouraged me to incorporate mobile ASR in the treatment phase of this investigation.

The Effectiveness of Reading Aloud Techniques

Reading Aloud vs. Silent Reading. A review of literature on reading and its contribution to language acquisition revealed that the focus of the existing research is mostly on silent reading (Carrell & Eisterhold, 1983; Clarke & Silberstein, 1977; Goodman, 1973). RA has not received much attention and, instead, was criticized for hindering comprehension and focusing more on pronunciation. The criticism is based on the observation that RA can interfere with reading comprehension because it increases mental efforts in addition to the semantic processing of the text (Gabrielatos, 2002). RA is also thought to be ineffective to develop reading skills because learners need to learn, retain, and retrieve pronunciation, which may not help with sound-form-meaning associations because learners are not able to pay much attention to meaning while reading aloud (Gibson, 2008). Nevertheless, for these same reasons we can argue for the possibility that RA constitute an effective method to improve L2 pronunciation. My intention is to use RA as a tool to improve pronunciation, not meaning or comprehension.

Gabrielatos (2002) and S. Fuchs, D. Fuchs, Hosp, and Jenkins (2001) discussed RA and its relationship to pronunciation and comprehension from different perspectives. Gabrielatos

(2002) made a distinction between reading for comprehension and sounding out words. The former is better achieved through silent reading and the focus is more on content words whereas in RA the attention of the reader is spread equally on all words. RA can be used to raise learners' awareness of pronunciation features (e.g., stress, rhythm, sounds and their interaction between endings and beginnings of words), provide practice in certain phonological aspects, and facilitate the production of spontaneous speech to communication (Gabrielatos, 2002; Ibarrola, 2011).

On the other hand, Fuchs et al. (2001) suggested an integrative function of RA that relates pronunciation and comprehension. He described what he termed "oral reading fluency" as a multifaceted process in which the reader has to perceive the letters and translate them into accurate sound representations, access lexical representations, process meaningful connections within and between sentences, relate text meaning to prior information, and make inferences to supply missing information.

In spite of the aforementioned benefits of RA, there are only a handful of studies that can support or refute its effects on L2 pronunciation. Before discussing these studies, it is noteworthy to mention that an examination of the current research on RA revealed that RA-based techniques such as shadowing, mimicking, and Readers Theatre are widely used in classrooms and have received more attention by researchers.

RA-Based L2 Learning Techniques. Celce-Murcia et al. (1996) pointed out that shadowing, repetition, mirroring, and imitative conversation techniques are used as oral teaching methods in which L2 learners imitate native speakers' intonation patterns. The shadowing technique requires learners to instantaneously listen and imitate the utterances produced orally by native speakers as closely as possible. Studies on shadowing demonstrated that the participants

used language processing strategies at the bottom-up level (e.g., phonology, morphology, word recognition, and syntax) and other strategies such as inference and elaboration to resolve comprehension problems (Commander & de Guerrero, 2013). Other studies found that it helped learners improve in oral fluency (Hsieh, Dong, & Wang, 2013; Zakeri, 2014) and intonation (Hsieh, Dong, & Wang, 2013).

Another pedagogical technique that has been researched is Readers Theatre, particularly its role in developing fluency and comprehension (Carrick, 2006). This technique incorporates oral reading, literature, and performing acts. Learners are involved in reading scripts orally and use facial expressions and body movement to depict attitudes and emotions of characters in the text. The findings showed that Readers Theatre may help learners increase their reading rate and word recognition and develop reading fluency and comprehension. It also provides opportunities for learners to use appropriate voice quality, intonation, and pitch to convey characters' attitudes and emotions.

Mimicking is another technique that proved to be useful in reducing foreign accent. Hilton (2005) recounts how mimicry helped him and his students reduce their English accent when learning L2 Spanish. Hilton (2005) adopted the mimicry method in a campus speech clinic and used it with university students who requested accent reduction therapy. Learners practiced accented mimicry of people they knew in their L1 first to be familiar with mimicry techniques. Then, learners engaged in L2 mimicry by orally reading written scripts of conversations. The author found it useful to use written scripts instead of spontaneous speech, especially for students whose L2 proficiency was low and struggled in free speech.

The common and crucial denominator among these techniques (i.e., shadowing, Readers Theatre, and mimicking) is the inclusion of oral reading. Unfortunately, the role of RA in the efficacy of these techniques in learners' oral performance and achievement has not been addressed in any of the studies currently available. The findings were attributed to the effects of imitation and repetition, not to RA.

RA Effects on L2 Pronunciation. The studies that investigated the role of RA in the improvement of L2 pronunciation are scarce. Romwapee (2012) examined the effects of reading-aloud domino games on the pronunciation of word-initial /v/, /θ/, and /ð/ by Thai learners of English as well as the attitudes of the participants towards the usefulness of RA. Seven junior high school students participated in this study. In the treatment phase, the participants read monosyllabic words on both sides of 48 cards. The words were divided into three sets: the /v/ set consisted of 10 words beginning with /v/ in addition to words beginning with /f/ and /w/, which are the phonemes realized by Thai speakers when they attempt to pronounce the English /v/. The /θ/ set consisted of 10 words in addition to words beginning with the perceptually ambiguous (in Thai) /s/ and /t/. Finally, the third set consisted of words beginning with /ð/ in addition to words beginning with /t/ and /d/. The study followed a one-group research design with a pre-test and a post-test. During both tests, the participants had to read a list of words with the target sounds. The findings showed statistically significant improvement in the pronunciation of /v/, /θ/, and /ð/ from the pre-test to the post-test. In addition, the qualitative aspect of the research revealed highly positive attitudes of the participants towards using reading-aloud dominoes. Similar positive results were found in Tam (1997) and Tost's (2013) studies, as will be discussed next.

Tam (1997) described the effects of a speech course tried out with 16 post graduate Chinese ESL learners. The course lasted for six three-hour sessions in which the participants completed three activities in each session: fluency practice, dialogue practice, and oral reading. Fluency practice required the participants to work in groups of four. They took turns talking about topics of their choice and provided immediate feedback to each other on pronunciation, voice quality, and organization of ideas. In the dialogue practice, the participants were asked to produce reduced forms of speech (i.e., contraction, elision, and assimilation) after listening to slow, relaxed, and fast versions of pronunciation. They were asked to converse in pairs or groups of three using full texts. In the oral reading activity, the students practiced sound/spelling correspondences, placement of stress, and rhythm. Students also worked in groups of three in which one read aloud to the other two participants who listened and gave feedback. The analysis of the interviews with the participants revealed that the greatest improvement of this pedagogical activity was in pronunciation.

In Tost's (2013) study, the researcher investigated whether RA in small groups improves English pronunciation and fluency in reading and whether students' cooperation help improve reading. The researcher hypothesized that there would be a difference between the first and third readings and that the cooperation of students would improve reading skills. To test these hypotheses, the researcher recruited a class of 20 Spanish adult beginner ESL students (aged 18-55) in Spain. The participants worked in asymmetric groups of three or pairs. Each group consisted of one more capable student and two less capable students. Students in each group took turns reading aloud a letter, designed by the researcher to focus on particular vocabulary, and the listeners had to follow it, give feedback, and keep a record of self- and peer-corrections. This

process was repeated three times in each group. The findings demonstrated that the participants' pronunciation of the target vocabulary improved from the first and third readings. According to the researcher, RA forced learners to "work a system of word-sound recognition". These findings suggested that students should develop phonological awareness in order to make their production intelligible. The interviews with the participants showed that they were conscious of their improvement in pronunciation during RA and speaking.

One could argue that the positive findings in the above studies (Romwapee, 2012; Tam, 1997; Tost, 2013) could be the result of having the participants work in groups, which could have helped them learn from each other and not from RA activities. Another shortcoming of these studies, particularly Romwapee (2012) and Tost (2013), is that they did not examine the effects of RA on L2 learners' pronunciation in free speech. Ibarrola (2011) addressed these two limitations in a study that investigated the effects of RA on learners' improvement of segmental and suprasegmental features of English pronunciation, and whether the improvement would transfer to their free speaking. Fifteen 20-year-old Spanish university students participated in this study. The treatment course lasted for 14 weeks and involved one hour of instruction per week of basic knowledge of English phonology and two hours per week of practical workshops. In the practical workshops, the participants listened to oral recordings of English texts and imitated them by reading texts out loud. After each RA training, the participants met the teacher to read the text orally. The participants were asked to record their first reading, the last reading in the course, and a one-minute free speech on a particular topic. The analysis of these recordings, along with the individual questionnaire, confirmed the researcher's first hypothesis that RA would improve learners' pronunciation from the pretest to the posttest. The second hypothesis

that learners' improvement would transfer to their free speech was not confirmed, especially the suprasegmental features targeted in the investigation. A major problem with this finding is that the participants' free speech was compared to their performance in reading on the posttest (at the end of the course). Logically speaking, the performance of the participants in reading texts aloud and imitation should be better than in free speech (Rau, Chang, & Tarone, 2009; Tanner & Landon, 2009). A more significant finding could have resulted if the participants' spontaneous oral interactions were recorded before and after the treatment and then compared in order to detect any improvement. An analysis of the questionnaire showed that the participants thought that RA was useful and that it raised their awareness of their pronunciation errors, the importance of intonation, and encouraged them to focus on pronunciation.

Although the findings in these studies showed improvements in the participants' pronunciation, we cannot conclude that RA alone was the factor that led to these results. First, in Romwapee's (2012) study, the participants received explicit instruction on particular features (e.g., aspiration, silent /l/, long vowels and diphthongs) and watched short videos on phonetics before the treatment. Similarly, the participants in Ibarrola's (2011) study received one hour of instruction per week of basic knowledge of English phonology. In Tam (1997) and Tost's (2013) studies, the participants worked in groups and this could have helped the participants learn particular pronunciation features from each other and through constant provision of feedback and explicit instruction. Second, all these studies followed a one-group research design. There was not a control group in any of the studies to ascertain the fact that RA alone contributed to learning.

The Purpose of the Present Study. This study contributed to this area of research by filling the gaps discussed above. It focused on the effects of RA on L2 pronunciation without explicit instruction and included a control group. The study addressed the effects of RA on the acquisition of two English phonemes /p/ and /ε/ in both reading aloud and spontaneous speech tasks. The targeted pronunciation features were chosen for two main reasons.

First, Arab learners of L2 English, the targeted participants in this study, have difficulty producing these sounds because they are not part of the Arabic phonemic system (Al-Badawi, 2012; Al-Saidat, 2010; Avery & Ehrlich, 1992; Barros, 2003; O'Connor, 1980; Oshida, 2003; Smith, 2001). These learners confuse the high front lax /ɪ/ as in 'bit' with the mid front lax vowel /ε/ as in 'bet' and, accordingly, they tend to produce a variant of /ɪ/ for both phonemes. They also tend to produce the voiceless bilabial stop /p/ as /b/ because the former has no equivalent sound in Arabic.

Second, the phonemes /p/ and /ε/ have high functional load in English. Functional load refers to the importance of particular phonemes over other phonemes in a language. The phonemes with high functional load are the most frequent and contrast with other acoustically different phonemes in a significant number of words (Brown, 1988; Koffi, 2013). For example, as opposed to relatively rare /θ/ (as "th" in think), the phonemes /p/ and /b/ are highly frequent in English and, in addition, they contrast many words in the language (i.e., they form a large number of minimal pairs; e.g., pin-bin; pen-ben; pack-back). The mispronunciation of these sounds may lead to confusion and communication breakdowns as they serve to differentiate many English words.

In his analysis of Received Pronunciation of English phonemes, Brown (1988) ranked the pair of phonemes /p, b/ at the highest level of importance among consonants and /ε/ at the second highest level among vowels in a 10-point scale in which 10 represents the most important and 1 the least important. Similar patterns were also described by Koffi (2013), based on an analysis of the 10,000 most frequent words of North American English. In sum, the target phonological features for this study are the phonemes /p/ and /ε/ because they are problematic for the targeted group of participants (Arab L2 learners of English) and because they have high functional loads in English.

The study attempted to answer the following three research questions:

- (1) Does RA lead to the improvement of Arab learners' pronunciation of /p/ and /ε/ in reading aloud activities?
- (2) Does RA lead to the improvement of Arab learners' pronunciation of /p/ and /ε/ in free speech?
- (3) What are the participants' attitudes towards ASR-based reading aloud activities?

Based on previous research findings (Ibarrola, 2011; Romwapee, 2012; Tam, 1997; Tost, 2013) and the general SLA literature discussed earlier, I hypothesize that RA has the potential to help L2 learners improve their oral production when orally reading the target sounds embedded in phrases and in larger texts. Accordingly, I also hypothesize that learners' improvement in /p/ and /ε/ RA activities would transfer to their spontaneous speech. In Ibarrola's (2011) study, the participants' improvement in free speech was not significant mainly because their performance

in free speech was compared to their performance in reading a text orally. Therefore, this study compared the performance of the participants in free speech in three occasions.

Chapter 3: Method

Participants

The study took place in a private school in Dubai, United Arab Emirates. A total of 40 adults were initially invited to participate in this study and in return benefit from free ESL classes to improve reading comprehension and writing skills. The participants were the researcher's colleagues and alumni who were given an invitation (e.g., via a recruitment advertisement) and, further to the invitation, a consent form to participate in this study. However, after conducting the pretest, 14 people were eliminated either because they did not have difficulties producing the targeted features or their English proficiency was advanced. The remaining 26 adults, average age was $M = 21.8$ ($SD = 6.61$), were Arabic-native speakers, twenty-five males and one female, representing five different countries (Egypt, Syria, Saudi Arabia, Jordan, and the UAE). All of the participants were university educated and their English language proficiency ranged between low to high intermediate based on their reports on the background questionnaire. The participants were randomly assigned to two groups, the experimental group (the treatment group) and a control group via Research Randomizer (Social Psychology Network; <https://www.randomizer.org>), a free web-based service that offers instant random sampling and random assignment of participants.

Procedure

A background questionnaire (Appendix A) was given to the participants to collect their biographical and language experience information before the experiment. The completion of the questionnaires lasted approximately seven minutes.

Regarding the instructional materials, in addition to the free ESL classes (i.e., reading comprehension and writing) given to all participants in both groups, the experimental group was engaged in RA practice (e.g., the ASR-based reading aloud of 12 passages), whereas the control group did not engage in any form of RA activity. Instead, they received the same texts given to the treatment group but the focus was on comprehension (i.e., they read the texts silently and answered multiple-choice comprehension questions). So, the two groups were exposed to the same texts, but they differed in the type of assignment. While the experimental group practiced RA of the assigned texts via ASR, the control group was given additional reading comprehension tasks for the same assigned texts. The experimental group practiced the reading aloud of specifically designed texts using Dragon Dictation (see Appendix B), a free commercial ASR application installed in their smartphones (i.e., the app can only be installed on iPhones). The participants were given a total of 12 short texts (200-250 words) taken from news articles and ESL textbooks that covered a variety of topics that were deemed level-appropriate and interesting for the participants (see sample in Appendix C). Each of these texts was carefully selected to include several instances of the targeted phonemes /p/ and /ε/. Using the assigned ASR application (app), the participants were asked to read the texts orally into the microphones of their mobile devices. They were not supervised during the reading practice, but they were required to email the researcher the passages that they practiced (i.e., read aloud) and typed by the ASR app. This requirement helped ensure that the participants practiced RA through ASR app. It is worthy to note that the participants did not listen to any modeling of the targeted pronunciation during reading practice as well as during testing.

As part of its capabilities, the ASR app provided instantaneous feedback on the participants' production in the form of written text. When the participants' production was

erroneous (e.g., they said ‘ben’ incorrectly instead of ‘pen’), they were able to identify the error via the spelling provided by the speech recognizer. The treatment lasted for two consecutive weeks during which the participants were assigned one read-aloud text per day. The control group was not engaged in any type of RA activity; instead, they received the same texts given to the treatment group and were asked to answer comprehension questions. Both groups were exposed to the same ESL materials and content, but they differed in the types of activities they were asked to perform.

As for the testing materials, the same test (Appendix D) was used in the pre-test, post-test, and the delayed post-test. The test comprised three tasks: reading aloud of Word List (WL), reading aloud of Text (TR), and Free Speech (FS).

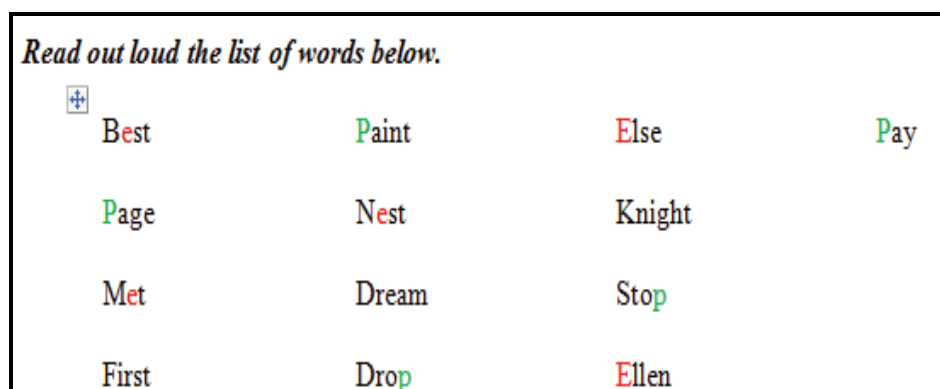


Figure 1: Task 1 (Word List reading task)

In the first task (Figure 1), the participants were asked to read a list of 13 monosyllabic words. Five words targeted the /p/ sound in which /p/ occurred as an onset (syllable-initially) in three words (*page*, *paint*, *pay*) and as a coda (syllable-finally) in two words (*stop*, *drop*). The phoneme /ɛ/ occurred in five words, three times after an onset (*best*, *nest*, *met*) and twice word-initially (*else*, *Ellen*). The remaining three words (*first*, *dream*, *knight*) served as distractors.

In the TR task, the researcher introduced a written passage to the participants that targeted the production of two phonemes /p/ (18 types / 22 tokens) and /ε/ (15 types / 15 tokens). The phoneme /p/ occurred as an onset in 11 word types (*picked, plenty, packed, planned, complete, plane, problem, put, apart, person, people*), and as a coda in seven word types (*trip, stop, sleep, step, help, up, hopeless*). As for the phoneme /ε/, it occurred in word-initial position (as an onsetless syllable) in four word types (*every, end, edge, effort*) and was preceded by an onset in 11 word types (*Delhi, plenty, step, help, when, attendant, several, next, friend, said, left*).

In the FS task (Figure 2), the participants described 11 pictures; each of these pictures targeted one of the two phonemes under investigation. Five pictures targeted the phoneme /p/, five pictures targeted the phoneme /ε/, and three pictures served as distractors (*muffins, donuts; kiwi; turkey*). The participants were asked to orally describe one picture at a time. The phoneme /p/ occurred in five words, three times as onsets (*toothpaste, perfume, pets*) and twice as codas in the other remaining two words (*ship, lipstick*). The phoneme /ε/ occurred in six words, once in an onsetless syllable (*eggs*) and five times was preceded by an onset (*bells, desk, leg, neck, pets*).

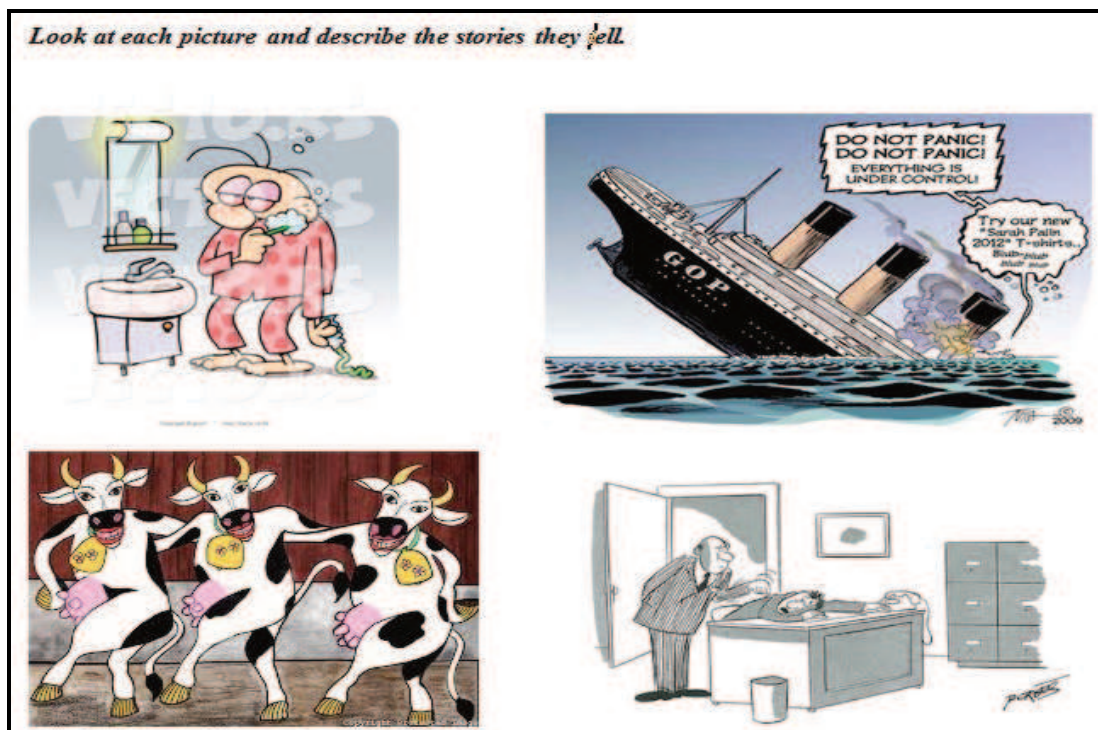


Figure 2: Task 3 (Free Speech task)

The pre-test was administered in the first week before the treatment in order to assess all participants' pronunciation of the target sounds. The assessment was the criterion through which the participants who did not have serious pronunciation problems were eliminated (those who scored more than 45% of accurate production of the target phonemes). The test helped the researcher to determine whether the two groups were comparable prior to the treatment, and it served to establish a baseline against which learners' performance was compared after the treatment.

The post-test took place immediately after the treatment and comprised the same tasks conducted in the pre-test. The participants' performance in the post-test was compared to that of the pre-test to detect any development in the two groups' performance. The delayed post-test was conducted one week after the treatment in order to assess whether the participants who showed

improvement in the production of /p/ and /ε/ were able to maintain the acquired knowledge over time. The one week interval between the two post-tests was convenient for most participants as they had plans to travel or be absent for personal matters.

Finally, immediately after the delayed post-test, the participants in the experimental group were asked to answer a questionnaire (Appendix E) in order to assess their attitudes towards their experience practicing RA in general, the strengths, and the weaknesses of RA activities via ASR app. The participants were instructed to write their answers in the language with which they felt more comfortable, Arabic or English.

Design

The study followed a mixed-methods research design including both quantitative and qualitative data and analyses. For the quantitative data, a pre-test/post-test/delayed post-test research design was adopted with a control group and an experimental group. A repeated measures design with ANOVAs was found appropriate to compare the two experimental groups' performance on the three tests. The tests measured the effects of the treatment on the participants' improvement and retention of the target pronunciation at different points in time. The qualitative aspect of the study examined the experimental group's attitudes towards the usefulness of RA reflected on their responses in the interview questionnaire.

Data Collection

The study used three different instruments for data collection: (a) participants' background questionnaire; (b) pre-test, post-test, and delayed post-test audio recordings of the participants' production of /p/ and /ε/; (c) a post experiment questionnaire. The following is a detailed description of each data collection tool and procedure.

Participant Background Questionnaire. Demographic information was collected in order to examine the participants' variables and the possible impact they may have on the results of producing the targeted features. The questionnaire included questions about language background (i.e., Arabic, English, and any second or third language), education, time spent in English-native speaking countries, and English proficiency level (see Appendix A).

Testing Measures. The quantitative data were collected from the audio-recorded productions of the participants elicited from the two reading aloud tasks (WL and TR) and the free speech (FS) task conducted in the pre-test, post-test, and the delayed post-test. For the recording sessions, one-to-one meetings were held with the participants in a quiet room at their school. The relevant aspects of the recordings (i.e., their production of /p/ and /ε/ phonemes) were later transcribed and coded independently by the researcher and two other raters for accuracy. Every correct pronunciation of the target segments in the two reading tasks (i.e., WL and TR) was given one point while their incorrect productions were assigned no points. To ensure inter-rater reliability, the rating of the three raters was compared to detect any discrepancies. The inter-rater reliability was found to be 98.4 % indicating that the raters disagreed on 50 productions in total. At least two raters agreed on 40 instances of these productions, but the three raters disagreed on 10. In these 50 cases, the three raters re-listened to the recordings of the disputable tokens and made final decisions. These data were analyzed in order to answer the first research question of whether RA leads to an improvement in the learners' production of /p/ and /ε/ phonemes in the reading tasks.

The same procedure was applied to the analysis of the data obtained in the FS task: The correct production of each target phoneme was given one point while the incorrect production received a zero. These data were elicited to answer the second research question on the

participants' ability to transfer the acquired target sounds to free speech. The delayed post-test data were analyzed to find out if the experimental group would maintain any possible improvement detected on the post-test.

The Raw scores of every participant in the two reading aloud tasks and free speech in the pre-test, the post-test, and the delayed post-test were compiled into a spreadsheet for statistical analysis. Scores were calculated to derive the means and standard deviations. Subsequently, ANOVAs were administered using SPSS in order to determine whether there is a significant difference between the two groups over time.

Post Experiment Questionnaire. The qualitative data were collected from written responses of 10 randomly selected participants' from the experimental group. The participants' responses were collected to answer the third research question regarding attitudes towards RA activities. The questions prompted the participants to brainstorm the strengths and weaknesses of reading aloud tasks and ASR and what improvement, if any, they believed they had acquired. The participants' responses were analyzed in order to identify patterns and recurring themes. Their statements were grouped in general thematic topics related to the strengths and weaknesses of the experiment.

Chapter 4: Results

Data Analysis

Quantitative Data. Before answering the research questions, it is important to report that the investigation of /ε/ production was discontinued after the pre-test. The pre-test results showed that the 26 participants in both groups did not have major problems in producing /ε/ in the three tasks. The participants' mean scores were $M = 4.5/5$ ($SD = 0.7$) on the WL reading test, $M = 14.4/15$ ($SD = 0.8$) on the TR test, and $M = 5.6/6$ ($SD = 0.6$) on the FS test. These results indicated that the participants had already achieved target-like performance before the start of the experiment, and, therefore, the segment /ε/ was removed from further analysis.

On the other hand, the pre-test results on the production of /p/ showed low mean scores for all participants, in both experimental ($n = 13$) and control groups ($n = 13$) on the three tasks. The participants' mean scores were $M = 0.92/5$ ($SD = 0.72$) on the WL task, $M = 6.23/22$ ($SD = 3.1$) on the TR task, and $M = 0.80/5$ ($SD = 0.74$) on the FS test. In sum, these scores indicated that the participants had major problems in producing /p/ in reading and in speaking tasks.

The pre-test results also revealed that there were no significant differences between the experimental group $M = 7.54$ ($SD = 3.28$) and the control group $M = 8.46$ ($SD = 3.75$), $t(24) = 0.6658$, $p = 0.5119$ and, hence, the two groups were comparable. Therefore, a two-way ANOVA test was conducted to compare the performance of both groups, within and between subjects in the production of /p/ in three different points of time (e.g., pre-test, post-test, and delayed post-test). The results of the ANOVAs indicated that there was a statistically significant main effect, $F(1, 12) = 1507.1$, $p < .001$, between the two groups on their total performance on the two post-tests.

In order to respond to the first and second research questions of whether reading aloud via ASR technology leads to an improvement of Arab learners' pronunciation of /p/ in RA (WL and TR) and free speech (FS) tasks, descriptive statistics were used to calculate the results of these tests. The results indicated that there was a statistically significant effect of the treatment on the experimental group in the WL task, $F(1, 12) = 350.64, p < .001$, in the TR task, $F(1, 12) = 777.61, p < .001$, and in the FS task, $F(1, 12) = 907.6, p < .001$. Table 1 shows the overall descriptive statistics for the WL, TR, FS tests results overtime (pretest and the two post-tests).

Table 1

Descriptive Statistics for the three tests: Word List, Text Reading, and Free Speech

Task/TNI*	Group	Pre-test		Post-test		Delayed Post-test	
		M	SD	M	SD	M	SD
WL/5	Experimental	1.00	0.81	3.62	0.50	4.31	0.63
	Control	0.92	0.64	0.77	0.72	0.92	0.49
TR/22	Experimental	5.77	3.11	17.85	1.14	17.46	1.05
	Control	6.69	3.14	6.23	1.96	6.53	2.53
FS/5	Experimental	0.77	0.72	3.69	0.48	3.00	0.81
	Control	0.85	0.80	0.77	0.59	0.84	0.37

* Total Number of target Items in each task

As indicated, the results demonstrate an increase in mean scores from pre-test to post-test and delayed post-test for the experimental group in the reading and speaking tasks. In the WL task, the experimental group's mean score on the pretest ($M = 1.00, SD = 0.81$) increased significantly on the post-test ($M = 3.62, SD = 0.50$) and on the delayed post-test ($M = 4.31, SD = 0.63$). Similarly, in the TR task, the mean score on the pretest ($M = 5.77, SD = 3.11$) significantly

increased on the post-test ($M = 17.85$, $SD = 1.14$) and on the delayed post-test ($M = 17.46$, $SD = 1.05$). In the FS task, the mean score of the experimental group increased significantly from the pre-test ($M = 0.77$, $SD = 0.72$) to the post-test ($M = 3.69$, $SD = 0.48$) and the delayed post-test ($M = 3$, $SD = 0.81$) whereas the control group did not make any improvement overtime. This suggests that the experimental group's improvement in RA has positively influenced their spontaneous production of /p/ in the FS task. The increase in both RA and FS tasks for the experimental group suggests that this group benefitted from the ASR-based RA treatment.

Qualitative Data. Qualitative data analysis was conducted to answer the third research question regarding the participants' attitudes towards ASR-based reading aloud activities. The responses of the 10 randomly selected participants in the experimental group touched on three major themes related to the scope of the study.

The first common theme detected in the responses of all participants was their perception of increased awareness of their L2 pronunciation errors, as expressed in the following three quotes:

“I now know my mistake. I can say p correct and also th...” (Participant E19)

‘Reading help me say sion and tion and when to say p and when to say b...’ (Participant E24)

“Before I always say b not p and now I can and also j and dj like jeep...” (Participant E5)

The second common theme elicited from the participants' responses was the immediate feedback provided by the ASR app. Many participants stated that the immediate feedback helped them repair their pronunciation instantaneously and, consequently, address their individual errors, as one participant put it:

“the app wrote the wrong word so I now my pronounciasion is wrong then I repeet the word many times when I repeat I know my mistake which is good...” (Participant E21)

In addition, six of the participants stated that the app helped them recognize the spelling of some words with which they were only familiar orally (e.g., “sea”, “population”, “fair”). However, some participants noticed that the ASR app cannot consistently give correct feedback on homophones:

“ ... sometimes I become angry because the app do not write the words I read they write other words like when I say sea the app cannot write it and write see ...” (Participant E7)

The third theme expressed in their responses was an increase in motivation to read out loud to test what they thought was the correct pronunciation for a given word or phrase. Most participants expressed their joy reading texts aloud and how proud they felt of themselves when the ASR app spelled their productions correctly:

“I feel really happy when the app writes the words that I read correctly and when I have mistake I read it again and again ...” (Participant E9)

“reading like this helped me to read too much and correct my mistakes all the time until i become better and i feel good when i dont do mistakes and to try more...” (Participant E14)

To sum up, the analysis of the responses of the 10 participants selected for the interview suggest that they view ASR-based RA activities as a positive pedagogical technique that can improve their learning experience, despite some of the limitations described by some.

Chapter 5: Discussion and Conclusion

This study examined the effects of RA on the acquisition of the phonemes /p/ and /ε/ in the speech of Arab speakers learning English as an L2. The findings of the pre-test revealed that the participants in both groups did not have any difficulties in producing /ε/ and, therefore, the investigation focused exclusively on the /p/ segment.

As illustrated in figure 3, the results of the immediate and delayed post-tests showed that the experimental group outperformed the control group on the production of /p/.

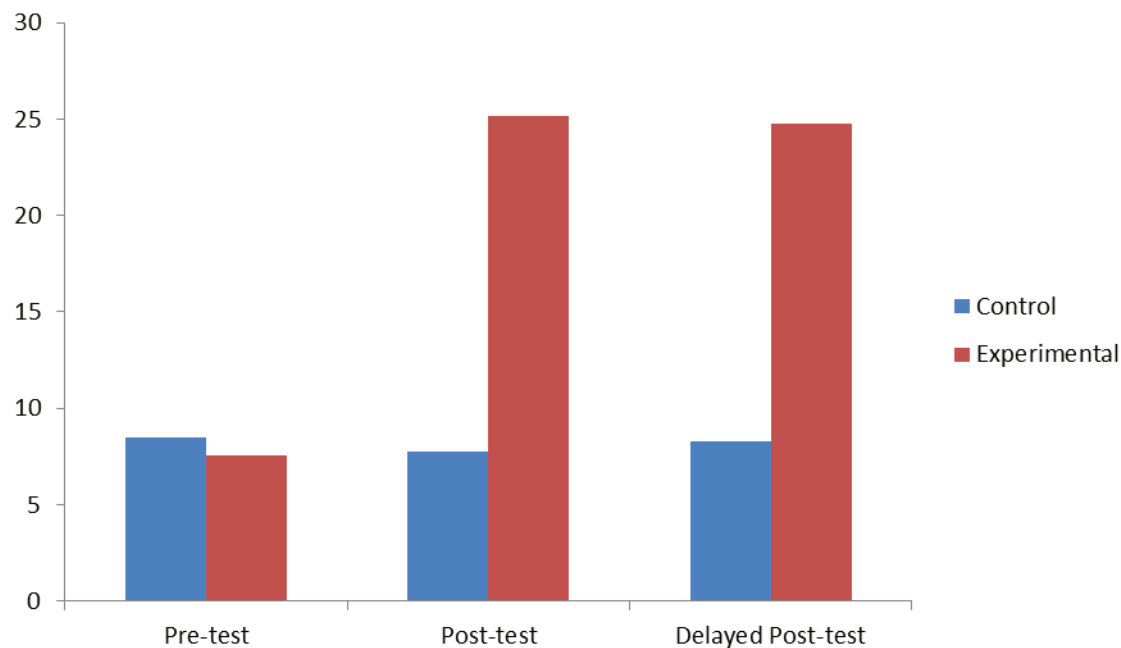


Figure 3. Experimental and Control Groups' Total Performance

The first research question aimed to investigate the effects of RA on the production of /p/ during two reading tasks. The results indicated that only the participants in the experimental group made significant gains on the two post-tests, thus supporting the findings of previous studies (Ibarrola, 2011; Romwapee, 2012; Tam, 1997) and confirming the first initial hypothesis.

The daily RA practice might have helped raise the participants' awareness of their errors and the target pronunciation and, consequently, it encouraged them to engage in hypothesis-testing during their attempts to produce the intended sound (Odisho, 2007). In other words, when the participants confronted familiar words or phrases, they compared and contrasted their erroneous production with the target production stored in their memory. This process might have led to self-correction. Thus, this awareness, along with daily exposure to problematic sounds and self-initiated ASR-assisted feedback, could have helped the participants acquire the target production. Furthermore, it is possible that the participants benefitted from learning in stress-free conditions provided by ASR, which could have motivated the participants to rehearse and correct themselves repeatedly, as recommended by CALL researchers (e.g., Chapelle & Jamieson, 2008; Lowther et al., 2008; Serhan, 2009).

The second research question investigated the effects of RA on the participants' spontaneous speech. Contrary to the findings of Ibarrola (2011), the experimental group in this study made significant improvements in the post-test, thus confirming the second hypothesis that the acquisition of the target pronunciation during RA would transfer to the participants' spontaneous speech. During the RA activities, the participants engaged in frequent self-repair. Frequent practice and repetition could have helped the participants make few instances of false starts and self-repair in free speech tasks during the two post-tests (see Larsen-Freeman, 2012 for similar claims). In Ibarrola's (2011) study, the transfer of the participants' improvement in reading texts to free speech was not confirmed probably because the participants' free speech was compared to their performance in reading on the post-test. In this study, however, the participants' description of pictures was recorded before and after the post-test. It is possible that reading several texts out loud and getting instantaneous feedback helped the participants become

conscious of their errors and, eventually, monitor their speech in the less controlled speaking environment that characterizes RA activities (see Epstein et al., 2002; Hew & Ohki 2004 for similar claims). The fact that the participants had to correct their errors through comparison of their oral production with the ASR-based written feedback might have helped them transfer the acquired knowledge to their spontaneous speech, as observed in previous research (e.g., Lyster & Ranta, 1997).

Another goal of the first two questions was to investigate whether the participants would maintain any improvement after the treatment phase on the delayed post-test. The findings showed that the experimental group maintained their improvement detected in the post-test.

Regarding the participants' attitudes towards and perceptions of RA, the participants enjoyed reading texts out loud and found it useful in improving their L2 pronunciation, as has been attested in previous studies (Romwapee, 2012; Tam, 1997; Tost, 2013). However, during the trial phase, the participants felt uncomfortable listening to their own voice. After days of practice, they became used to it and even managed to correct their errors on their own.

The interviews revealed that the participants felt that ASR-based RA activities provided them with instantaneous feedback on their pronunciation and a risk-free (technology-mediated) environment to practice reading texts orally without feeling anxious (Bradley & Lomicka, 2000; Baralt & Gurzynski, 2011). As a result, they were motivated to repeatedly monitor their production of English texts during the treatment phase (Neri, Cucchiarini, & Strik, n.d.). All of the interviewed participants attested that RA using an ASR-based application in their mobile devices made them aware of their errors, especially in pronunciation.

When asked how RA helped them improve their pronunciation, all interviewees stated that it helped them differentiate between /p/ and /b/ sounds. It is possible that the different

orthography of both sounds was either not evident for some or confusing for others (i.e., upper case vs. lower case letters). They also mentioned that RA through ASR encouraged them to engage in repeated practice so that they could recognize their errors and consequently attempt to improve them.

Some interviewees stated that RA training was an opportunity to see the written forms of familiar words. For others, RA helped them read diphthongs and consonant combinations (e.g., “ea”, “ou”; “th” and “cc”), properly pronounce “sion”, “tion”, and “ing”, and perceive the acoustic difference between /ʒ/ and /dʒ/. Thus, repetition and matching orthography with corresponding sounds could have helped these participants improve their pronunciation, a finding that is also observed in Bassetti’s (2015) study. The latter found that repetition and orthographic forms of word list positively affected learners’ pronunciation.

Finally, one of the participants stated that RA training was a great pedagogical experience because it increased his confidence every time he produced the target English form. In addition to vocabulary and sentence structure, he stated that the experiment improved his overall reading fluency through repetitive self-repair.

One of the limitations of ASR-based RA, which was pointed out by most participants, is that the ASR application utilized in this research (Dragon Dictation) has some technical shortcomings. The program did not always type the intended words as produced by the participant, but instead it selected homophones from its default memory. For example, “sea” was sometimes typed as “see” and “aisle” as “I’ll” when they were dictated without textual context, which was frustrating for many participants during the trial sessions. During the actual experiment, they were instructed to ignore homophones and to continue reading. Another deficiency of the program is that it may type the dictated text accurately even if it was

erroneously produced. For instance, the speaker may pronounce the word “hospital” as /'hɑ,sbɪtəl/ and, because of contextual and other phonetic cues, the app will not always detect the error and type the correct intended word.

Another limitation of this study is the focus on one segmental feature, the production of /p/. Initially, the investigation targeted two problematic features a vowel sound /ε/ and a consonant sound /p/ for Arab learners of ESL based on previous research findings (Al-Badawi, 2012; Al-Saidat, 2010; Avery & Ehrlich, 1992; Barros, 2003; O'Connor, 1980; Oshida, 2003; Smith, 2001). However, the pre-test results revealed that the participants in this study did not have major problems producing /ε/, indicating the existence of a developmental hierarchy in which the vowel is more easily acquired by the target population of learners. On the other hand, the claim that all Arab native speakers have difficulties producing /p/ is an overstatement. In this research, some participants were eliminated from the experiment because they pronounced /p/ accurately. The interesting finding was that they were all from North African Arab countries namely, Morocco, Algeria, and Tunisia. An investigation is in place to determine why some ESL Arab learners in the Middle East have difficulties pronouncing /p/ whereas those in North Africa do not.

Finally, another limitation is that the participants' improvement in this study could be the result of other factors and not only RA. For instance, the ASR app provided the participants with immediate and individualized feedback in risk-free conditions. Moreover, the participants' improvement could have been the result of the novelty effect. In other words, the improvement of the participants' performance could be the result of the increased interest in using the new technology and, hence, they became highly motivated to repeatedly practice reading and

correcting their production. One possible way to address this issue in future research is to add a third group in which the participants practice RA without the incorporation of ASR technology.

Further research on the use of ASR-based RA techniques to improve L2 learners' pronunciation is needed in order to address the limitations of this study and to fill the gap that exists in the SLA literature, particularly involving suprasegmental features such as stress and intonation. Moreover, the implementation of more advanced ASR programs would help researchers target these types of pronunciation features and address some of the limitations pointed out by the participants.

Although more research is needed to examine other pronunciation features, the findings observed in this study are encouraging, and the technology can be easily adapted to other language learning contexts. This investigation is based on the implementation of procedures that are feasible and easily replicable in regular second language classes. Teachers can incorporate RA as homework assignments or supplementary practice to address learners' pronunciation problems systematically and gradually throughout the academic year.

As demonstrated in the findings of previous studies and in this study, RA has the potential to provide learners with opportunities to listen and reflect on their own pronunciation of the target language as they pay more attention to the production of words and phrases than to their meaning and/or grammatical accuracy. Based on my ESL teaching experience, learners find it difficult to produce long talks during speaking tasks and confine themselves to the production of short and intermittent phrases, which does not constitute an ideal oral practice. On the other hand, when L2 learners are given texts to read aloud, they are expected to feel more comfortable and less anxious than in spontaneous speech because they do not have to worry about retrieving appropriate lexicon and monitoring grammatical errors. With the incorporation of a mobile ASR

app, students can practice independently for as many times as necessary to reach the target pronunciation, in an environment that is risk-free and that provides efficient and immediate feedback for hypothesis testing.

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Appendix A

Background Information and Language History Questionnaire

Contact Information (optional)

Name: _____

Email: _____

Telephone: _____

Please provide information for the following items:

1. Age: _____

2. Sex (underline your answer): Male / Female

3. Education: _____

4. Country of origin: _____

5. How long have you been living in Canada? _____

6. Please use the following scale to rate your languages skills:

1 = very poor; 2 = poor; 3 = fair; 4 = functional; 5 = good; 6 = very good; 7 = native-like; NA

= Not applicable

Languages	Reading	Listening	Writing	Speaking
First language: _____				
Second language: _____				
Third language: _____				

7. At what age did you start to learn your second language? _____

8. What language do you use the most at home? _____

9. What language do you use the most outside home? _____

10. How did you learn your second language?

- Classroom instruction _____

- Interaction with people _____

- Other (specify) _____

11. In your opinion, what is your level of English proficiency? Underline the appropriate answer.

- Beginner

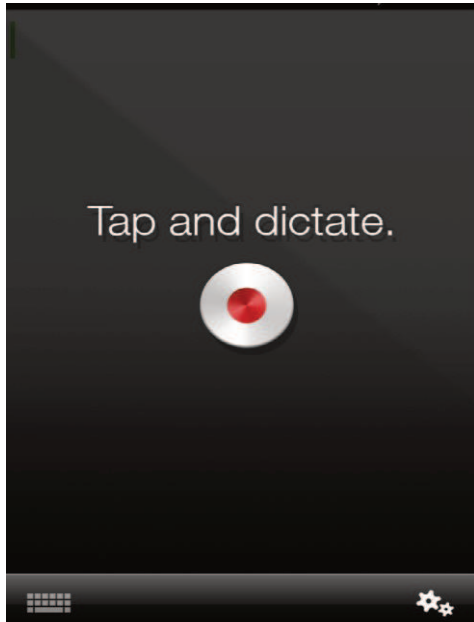
- Low intermediate

- Intermediate

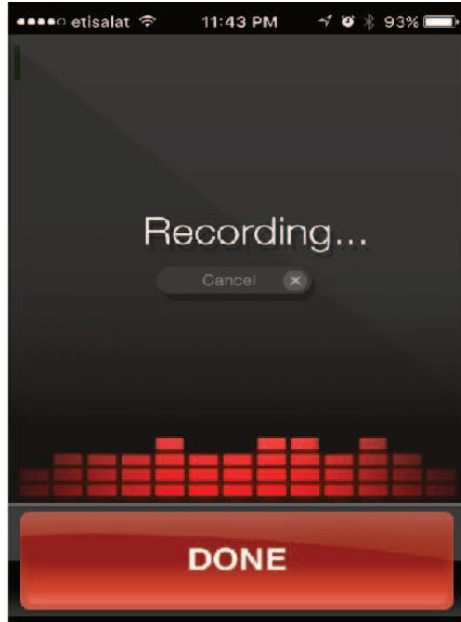
- High Intermediate

- Advanced

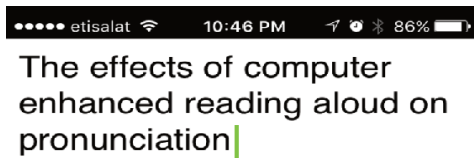
Appendix B



Tap to Start Recording



Dragon Dictation while Recording



Dragon Dictation Feedback

(Once the participants tap on the red button, the app starts recording the voice. The app transfers the voice to written text that can be used as feedback on how accurate the oral production is.)

Appendix C

Sample of reading aloud passage (22 words target /ε/ and 20 words target /p/)



My kind of holiday

She travels for her job, but when it's her own holiday, **Karen Saunders** stays at home.

Karen Saunders has her own travel agency in Mayfair, London that sends people all over the world on their dream holidays. She needs to know where she's sending them, so she goes on working holidays four or five times a year.

My ideal holiday

My ideal holiday has a little bit of everything. I like lazing on a beach with a pile of books, but then I get bored and I need to do something. I love exploring new places, especially on foot, and nosing around in churches, shops, museums, and restaurants. I'm very into cooking, so I love going around markets and food stores.

However, I must confess that my favourite 'holiday resort' is home. I travel so much in my job that just waking up in my own bed is heaven. I potter around the house in my pyjamas, read the paper, do some gardening, shop for some food, then make a delicious meal in the evening.

My business holidays

I have three trips coming up. I'm looking forward to going to Canada soon, where I'm staying for four nights at the Ice Hotel. This is a giant igloo situated in Montmorency Fall Park, just 20 minutes from downtown Quebec. It is made from 4,500 tons of snow and 250 tons of ice, and it takes 5 weeks to build. It will stay open for three months. When the spring arrives, it will melt. Then it will be built again for next year – maybe in a different place! Each room is supplied with a sleeping bag made from deer skins. The hotel has two art galleries featuring ice sculptures, and an ice cinema. It also has a bar where all the drinks come in glasses made of ice. Of course I'll visit them all!

THE BAOBAB RIVERS LODGE IN SELOUS, TANZANIA

– so remote, you arrive by boat!



WHAT TO SEE Each tree-top room has views over the vast forested banks of the Rufiji

Soars, L., & Soars, J. (2003). *New headway*. Oxford: Oxford University Press.

Appendix D

Testing Materials

Wordlist Reading Task (*Target phonemes: /ɛ/ is in red; /p/ is in green*)

Read out loud the list of words below.

Best	Paint	Else	Pay
Page	Nest	Knight	
Met	Dream	Stop	
First	Drop	Ellen	

Text Reading Task (*Target phonemes: /ɛ/ is in red; /p/ is in green*)

Read out loud the following passage.

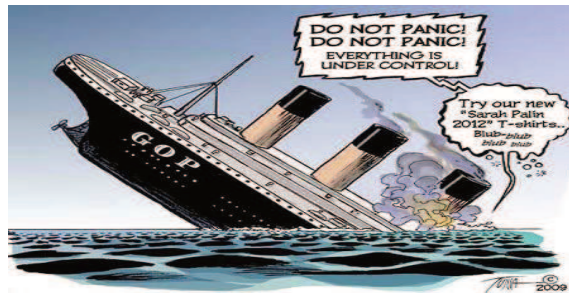
Travelling

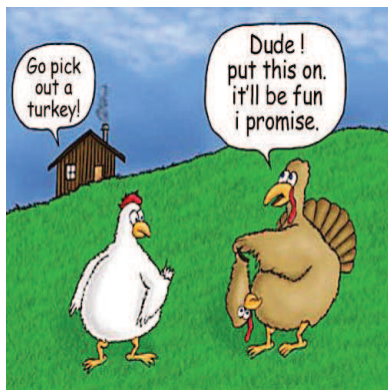
Every year, I travel to Northeast India with my husband. This is where his family and friends live. The trip takes 24 hours of time in the plane. On our first trip, we took a 14 hour flight from Chicago to Delhi. I like to read and write, so I thought I could bring plenty of things to do. I had packed many books, a journal and music. I thoroughly planned what I could complete during the flight so that I would not stop working and feel bored. My theory was ruined by one thing: my husband had picked us seats in the middle of a row at the back of the plane. My husband intended to sleep for most of the fourteen hours. It was not a problem for him to step over people to use the bathroom. He thought the noise would help us sleep. I was shocked when I saw where our seats were. After six hours of writhing in that packed condition, I decided to put an end to my situation. I told the attendant that I had a knee injury and that I hit it against the edge of the

seat. This was not the truth, but I said that because I was hopeless. I had to sit far apart from my husband, so I left him to his middle-row seat and was escorted to an aisle seat several rows up. I breathed with effort there. Fortunately the person who sat next to me did not intend to snooze either.

Speaking Task

Look at each picture and describe the stories they tell.





Targeted words: *bells, ship, desk, eggs, toothpaste, lipstick, leg, perfume, neck, pets*

Appendix E
Post Experiment Questionnaire

1. How would you describe your experience reading texts out loud?

2. Do you think reading texts aloud helped improve your English? If yes, in what way?

3. Describe the strengths of the reading aloud activities used in the study.

4. Describe the weaknesses of the reading aloud activities used in the study.
